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(54) Method of coating inorganic particles

(57) A single-stage method of providing inorganic particles with a polymeric organic coating comprises contacting inorganic particles with an organic compound in the presence of a corona discharge which is produced in a gaseous medium between two electrodes at least one of which is electrically insulated from the medium. The organic compound is caused to polymerise by the corona discharge and a polymer coating is formed on the inorganic particles.

Many types of inorganic particles can be coated such as pigments, fillers and extenders and inorganic borides, carbides and nitrides. The organic polymeric coating helps to improve the compatibility of pigments or fillers with organic media and tends to reduce the rate of hydrolysis of solids such as aluminium nitride.

The organic compound is, for example, a saturated or unsaturated hydrocarbon, a halogenated or an acrylic compound. In the examples titanium dioxide or aluminium nitride is coated with polyethylene. The gaseous medium is preferably an inert gas. In an apparatus for carrying out the process one electrode may comprise a cylinder and the other electrode is positioned within the cylinder along the axis thereof, and the barrier of insulating material is quartz or glass.

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This invention relates to a coating process and in particular to a method of coating inorganic particles with a polymeric organic material.

Coated particles of inorganic compounds are well known especially where the particles are used as pigments, fillers and extenders in systems such as paints, inks and plastics, since the coatings on the particles have been shown to improve the physical properties of the inorganic compounds. It is particularly desirable that pigment or filler particles should be readily dispersible in organic media in order to maximise their efficiency as additives. An organic coating on the inorganic particles renders them more compatible with organic media and hence more easily dispersed.

It is an object of this invention to provide a simple, single-stage method of providing inorganic particles with a polymeric organic coating.

According to the invention a process for coating inorganic particles with a polymeric organic material comprises contacting the particles with an organic compound in the presence of a corona discharge, the said corona discharge being produced by capacitively exciting a gaseous medium lying between two spaced electrodes at least one of which is electrically insulated from the gaseous medium by a barrier of electrically insulating material and said organic compound being a compound which is polymerised by the influence of said corona discharge.

microns and more preferably from 0.1 micron to 5 microns. When the inorganic particles are of titanium dioxide pigment their average particle size is preferably from 0.1 micron to 0.4 micron. Desirably the inorganic particles are in a finely divided state prior to coating and, if necessary, can be milled by any suitable means to achieve such a state.

Any organic compound which is polymerised by the influence of the corona discharge can be used in the process of the invention. Even many organic compounds not generally polymerisable by chemical techniques can be used. Preferably the organic compound is present in the process in the form of a gas or vapour and particularly suitable compounds are saturated and unsaturated aliphatic hydrocarbons such as methane, ethane, ethylene, butadiene and acetylene, aromatic hydrocarbons such as benzene, toluene and styrene, halogenated hydrocarbons such as chloroform, tetrafluoroethylene, carbon tetrachloride and tetrafluoromethane and acrylic compounds such as acrylonitrile, acrylic acid, methacrylic acid and acrylic or methacrylic esters.

The corona discharge is produced by capacitively exciting a gaseous medium. This medium can be any medium which is ionised by the corona discharge but, typically it consists of an inert gas such as argon, helium or nitrogen.

A feature of the gaseous medium when subjected to the corona discharge is that the electrons produced by ionisation possess relatively high energies by comparison with the molecules of the

has been found suitable. The energy input is usually sufficient to produce at least 0.25 GJ/kg of the organic compound used.

A corona discharge may be maintained over a wide range of pressure conditions. Typically pressures of from 20 kPa to 1 MPa are used but a preferred pressure is from 80 to 120 kPa. A particular advantage of the method of this invention is the fact that it can be operated at approximately atmospheric pressure (100 kPa).

The inorganic particles may be brought into contact with the organic compound in any suitable manner provided that there is contact in the presence of the corona discharge. For example, when an ionisable inert gas is passed between a pair of electrodes which are arranged to produce a corona discharge there is produced on the downstream side of the electrodes a region known as the afterglow region. The inorganic particles can be introduced separately or in admixture with the organic compound into this afterglow region to produce a polymeric coating. Alternatively, the organic compound can be passed between the electrodes together with the ionisable inert gas and the inorganic particles introduced into the afterglow region.

The inorganic particles can be coated with the organic compound prior to the coated inorganic particles being subjected to the effect of the corona discharge.

In a particularly preferred embodiment the inorganic particles, an inert ionisable gas and the organic compound are passed between the electrodes in such a manner that the inorganic particles remain

electrode. This second electrode was insulated from the contents of the reactor by a quartz tube with a diameter of 8 mm. The assembly of reactor and electrodes was positioned with the axis of the reactor vertical.

5 Argon was introduced into the space between the electrodes at atmospheric pressure and a flow rate of approximately 1 l/min. A radio frequency power supply (EN1 Power Systems Model HPG-2) was connected to the two electrodes and adjusted to supply power at a rate of 50 watts. The frequency of the power supply was then
10 increased until a corona discharge was observed between the electrodes at a frequency of about 275 KHz.

Ethylene was then introduced into the space between the electrodes at a flow rate of approximately 0.03 l/min and the power supplied to the electrodes was increased to 75 watts.

15 Titanium dioxide powder which had previously been dried at 300°C was then dropped into the space between the electrodes at a rate of 1 g/min.

The coated titanium dioxide was collected in a trap positioned below the reactor and examined by electron microscopy. A uniform
20 coating of polyethylene approximately 5 nm thick was observed on the titanium dioxide particles.

Example 2

The reactor of Example 1 was modified by fitting a powder inlet to the quartz tube so as to allow powder to be dropped into the
25 afterglow region of the corona discharge when the reactor was

CLAIMS

1. A process for coating inorganic particles with a polymeric organic material comprising contacting the particles with an organic compound in the presence of a corona discharge, said corona discharge being produced by capacitively exciting a gaseous medium lying between two spaced electrodes at least one of which is electrically insulated from the gaseous medium by a barrier of electrically insulating material and said organic compound being a compound which is polymerised by the influence of said corona discharge.
2. A process according to claim 1 in which the inorganic particles are suspended in a mixture of the organic compound and an inert ionisable gas and the suspension thus produced is caused to flow between the spaced electrodes whilst a corona discharge is maintained in the region between the electrodes.
3. A process according to claim 1 or 2 in which the inorganic particles are particles of a filler, pigment or extender.
4. A process according to claim 3 in which the pigment is titanium dioxide pigment.
5. A process according to claim 1 or 2 in which the inorganic particles are particles of an inorganic nitride, boride or carbide.
6. A process according to any one of the preceding claims in which inorganic particles have a particle size of from 0.01 micron to 1 millimeter.

16. A process according to claim 15 in which the frequency is from about 100 KHz to about 20 MHz.
17. A process according to any one of the preceding claims in which an amount of energy equivalent to at least 0.25 GJ/kg of organic compound used is supplied.
18. A process according to any one of the preceding claims in which the gaseous medium is maintained at a pressure of from 20 kPa to 1 MPa.
19. A process according to claim 18 in which the pressure of the gaseous medium is from 80 kPa to 120 kPa.
20. A process according to claim 19 in which the pressure is approximately 100 kPa.
21. A process according to claim 1 in which an inert ionisable gas is caused to flow between a pair of electrodes whilst a corona discharge is generated within said gas and the inorganic particles are contacted with the organic compound in the afterglow region which forms on the downstream side of the electrodes.
22. A process according to claim 1 in which the inorganic particles are coated with the organic compound prior to the coated particles so formed being subjected to the effect of the corona discharge.
23. A process according to claim 2 in which the proportion of organic compound in the inert gas is from 1% to 10% by volume.
24. A process according to claim 2 or 23 in which the weight ratio of inorganic particles to organic compound is from 30:1 to 1:2 by weight.

Amendments to the claims have been filed as follows

25. A process according to any one of the preceding claims in which one of the two spaced electrodes comprises a cylinder and the other spaced electrode is positioned within this cylinder and along the axis thereof.
26. A process according to any one of the preceding claims in which the barrier of electrically insulating material is glass or quartz.

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